Conservation of Momentum

NAME: .....

The following activities are based on PhysLet™ based simulations developed at Davidson College by professor Wolfgang Christian.

Elastic Collisions:

1) Preparation:
   a. Start this PhysLet™ simulation: http://science.kennesaw.edu/~tmzoughi/physlets/momentum2bcoll.htm
   b. Make sure that the "inelastic collision" check box remains unchecked.
2) Experiment:
   a. Equal masses equal speeds: Use the input boxes to input parameters such that the initial speed and the masses of both carts are the same. Mark your values here:

v_1 = ... m_1 =..... v_2 =..... m_2 =.....

Calculate the following quantities for before the carts collide:

P_1 = ... P_2 = ... P_{before} = ...

(Remember, P_{before} is the total momentum before. It is the sum of P_1 and P_2)

What do you expect will happen when the carts collide?.....

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Run the experiment and describe what you have observed? .....

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Mark the following values for after the collision:

v_1 = ... m_1 =..... v_2 =..... m_2 =.....

Calculate the following quantities for after the carts collide:

P_1 = ... P_2 = ... P_{after} = ...

(Remember, P_{after} is the total momentum before. It is the sum of P_1 and P_2)

Is there conservation of momentum?.....

   b. Equal masses different speeds: Use the input boxes to input parameters such that the masses of both carts are the same but their speeds are different. Mark your values here:

v_1 = ... m_1 =..... v_2 =..... m_2 =.....

Calculate the following quantities for before the carts collide:

P_1 = ... P_2 = ... P_{before} = ...

What do you expect will happen when the carts collide?.....

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Run the experiment and describe what you have observed? .....

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Mark the following values for after the collision:

v_1 = ... m_1 =..... v_2 =..... m_2 =.....

Calculate the following quantities for after the carts collide:

P_1 = ... P_2 = ... P_{after} = ...

Is there conservation of momentum?.....

c. Different masses equal speeds: Use the input boxes to input parameters such that the speeds of both carts are the same but their masses are different. Mark your values here:

v_1 = ... m_1 =..... v_2 =..... m_2 =.....

Calculate the following quantities for before the carts collide:

P_1 = ... P_2 = ... P_{before} = ...

What do you expect will happen when the carts collide?.....

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Run the experiment and describe what you have observed? .....

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Mark the following values for after the collision:

v_1 = ... m_1 =..... v_2 =..... m_2 =.....

Calculate the following quantities for after the carts collide:

P_1 = ... P_2 = ... P_{after} = ...

Is there conservation of momentum?.....

Inelastic Collisions:

1) Preparation:
   a. Start this PhysLet™ simulation: http://science.kennesaw.edu/~tmzoughi/physlets/momentum2bcoll.htm
   b. Make sure that the "inelastic collision" check box **is checked**.
2) Experiment:

a. Equal masses equal speeds: Use the input boxes to input parameters such that the initial speed and the masses of both carts are the same. Mark your values here:

v_1 = ... m_1 =..... v_2 =..... m_2 =.....

Calculate the following quantities for before the carts collide:

P_1 = ... P_2 = ... P_{before} = ...

What do you expect will happen when the carts collide?.....

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Run the experiment and describe what you have observed? .....

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Mark the following values for after the collision:

v_1 = ... m_1 =..... v_2 =..... m_2 =.....

Calculate the following quantities for after the carts collide:

P_1 = ... P_2 = ... P_{after} = ...

Is there conservation of momentum?.....

b. Equal masses different speeds: Use the input boxes to input parameters such that the masses of both carts are the same but their speeds are different. Mark your values here:

v_1 = ... m_1 =..... v_2 =..... m_2 =.....

Calculate the following quantities for before the carts collide:

P_1 = ... P_2 = ... P_{before} = ...

What do you expect will happen when the carts collide?.....

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Run the experiment and describe what you have observed? .....

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Mark the following values for after the collision:

v_1 = ... m_1 =..... v_2 =..... m_2 =.....

Calculate the following quantities for after the carts collide:

P_1 = ... P_2 = ... P_{after} = ...

Is there conservation of momentum?.....

c. Different masses equal speeds: Use the input boxes to input parameters such that the speeds of both carts are the same but their masses are different. Mark your values here:

v_1 = ... m_1 =..... v_2 =..... m_2 =.....

Calculate the following quantities for before the carts collide:

P_1 = ... P_2 = ... P_{before} = ...

What do you expect will happen when the carts collide?.....

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Run the experiment and describe what you have observed? .....

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Mark the following values for after the collision:

v_1 = ... m_1 =..... v_2 =..... m_2 =.....

Calculate the following quantities for after the carts collide:

P_1 = ... P_2 = ... P_{after} = ...

Is there conservation of momentum?.....

Explosions:

1) Preparation:
   a. Start this PhysLet™ simulation: http://science.kennesaw.edu/~tmzoughi/physlets/momentumexp.htm

(Please note that the explosion does not occur immediately, wait for it to happen.)

2) Experiment:
   a. Equal masses: Use the input box to input parameters such that the initial masses of both carts are the same. Mark your values here:

v_1 = ... m_1 =..... v_2 =..... m_2 =.....

Calculate the following quantities for before the explosion:

P_1 = ... P_2 = ... P_{before} = ...

What do you expect will happen after the explosion?.....

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Run the experiment and describe what you have observed? .....

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Mark the following values for after the explosion:

v_1 = ... m_1 =..... v_2 =..... m_2 =.....

Calculate the following quantities for after the explosion:

P_1 = ... P_2 = ... P_{after} = ...

Is there conservation of momentum?.....

b. Different masses: Use the input box to input parameters such that the masses of the carts are different. Mark your values here:

v_1 = ... m_1 =..... v_2 =..... m_2 =.....

Calculate the following quantities for before the explosion:

P_1 = ... P_2 = ... P_{before} = ...

What do you expect will happen after the explosion?.....

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Run the experiment and describe what you have observed? .....

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Mark the following values for after the explosion:

v_1 = ... m_1 =..... v_2 =..... m_2 =.....

Calculate the following quantities for after the explosion:

P_1 = ... P_2 = ... P_{after} = ...

Is there conservation of momentum?.....

Sling Shot:

1) Experiment:
   a. Start this PhysLet™ simulation: http://science.kennesaw.edu/~tmzoughi/physlets/momentumsling.htm

The purpose of this part is to try to identify the mass of larger ball and to observe what happens. Assume that the smaller ball has a mass of 1.0 kg.

Write the following quantities for before the balls collide, use an unknown M for the large mass:

P_1 = ... P_2 = ... P_{before} = ...

(It is quite acceptable to provide an expression instead of a value, remember, you don't know M. Also, be careful, you want the momenta just before the balls collide. That happens after the large ball bounces.)
What should the momentum after the collision be? (Remember conservation of momentum!)

P_{after} =.....

Write the following quantities for after the balls collide for the first time; use an unknown M for the large mass:

P_1 = ... P_2 = ... P_{after} = ...

Use the data gathered before and after the collision, and conservation of momentum to figure out the mass of the large ball:

M = ...

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Explain why this experiment called sling shot? .....

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Can you think of a way of duplicating this experiment in real life with real balls? Describe: .....

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Complicated Collision:

3) Preparation:
   a. Start this PhysLet™ simulation: http://science.kennesaw.edu/~tmzoughi/physlets/momentum-2d.htm

Write the following quantities for before the balls collide:

m_1 = ... v_{1x} = ... v_{1y} = ... P_{1x} = ... P_{1y} = ...

m_2 = ... v_{2x} = ... v_{2y} = ... P_{2x} = ... P_{2y} = ...

Calculate these:

$P_{x\text{-}before}$ = ... $P_{y\text{-}before}$ = ...

(Hint: $P_{x\text{-}before}$ is the total momentum before along the x. Which is the sum of P_{1x} and P_{2x})

Mark the following values for after the collision:

m_1 = ... v_{1x} = ... v_{1y} = ... P_{1x} = ... P_{1y} = ...

m_2 = ... v_{2x} = ... v_{2y} = ... P_{2x} = ... P_{2y} = ...

Calculate the following quantities for after the carts collide:

$P_{x\text{-}after}$ = ... $P_{y\text{-}after}$ = ...

Is there conservation of momentum? .....

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Opinion: Provide your feedback about this activity

What did this activity help you learn? .....

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What was confusing about this activity? .....

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How would you make this activity better? .....

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